Heraeus

Biofuge *primo R*

Instructions for use

How to use this manual

Use this manual to get acquainted with your centrifuge and its accessories.

The manual helps you to avoid inappropriate handling. Make sure to keep it always close to the centrifuge.

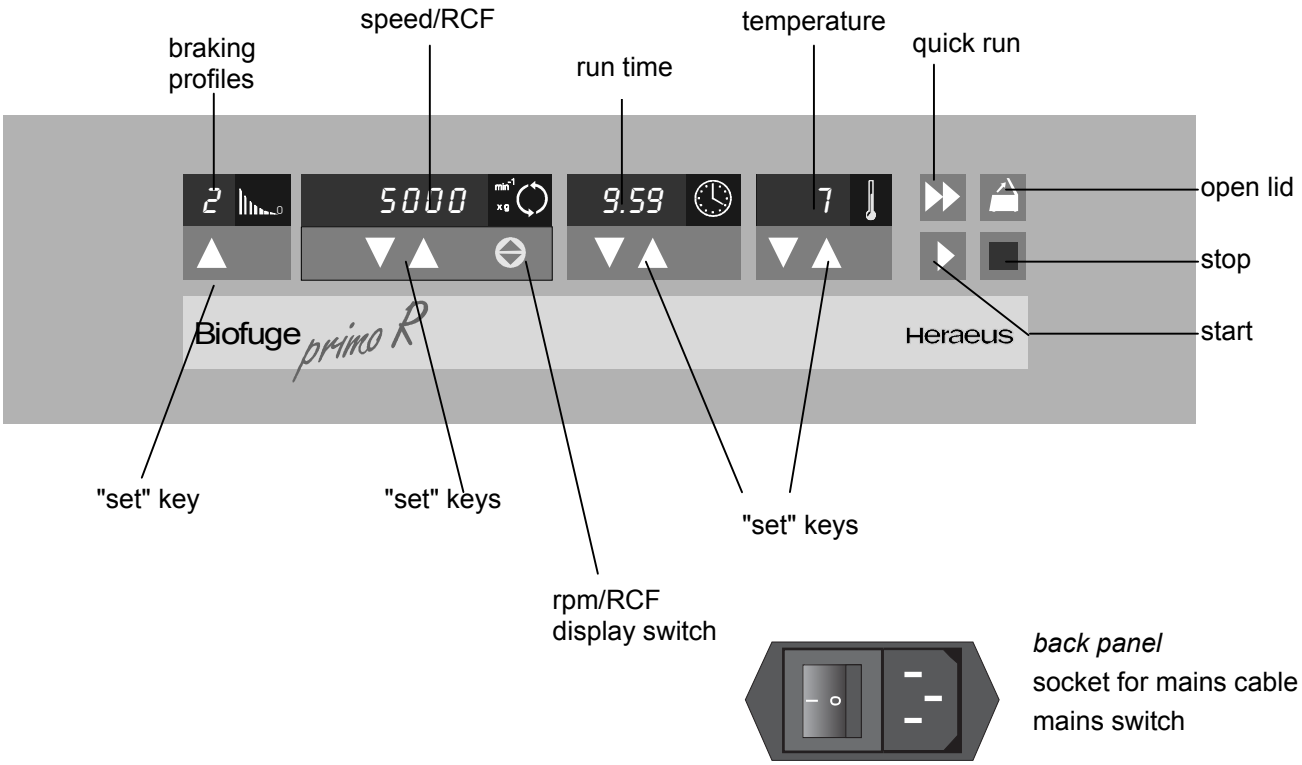
A manual that is not kept handy cannot provide protection against improper handling and thus against damage to persons and objects.

This manual comprises chapters on

- Safety regulations
- Instrument description
- Rotor program and accessories
- Transportation and hook-up
- Use of the centrifuge
- Maintenance and care
- Troubleshooting
- Technical data
- Index

Overleaf you will find a graphic representation of the control panel with a survey of the most important functions

Please fold out


braking profiles
speed/RCF
run time
temperature
quick run
2
5000
9.59
7
open lid
stop
start
Biofuge primo R
Heraeus
"set" key
"set" keys
rpm/RCF display switch
"set" keys
back panel
socket for mains cable
mains switch

Control panel of the *Biofuge primo R*

Display

Braking profiles

Continuous display : braking profile last used, 1 - 9;
2 - 9 = max. acceleration and various braking profiles (2 [weak] to 9 [strong])
1 = slow acceleration and braking curve 2

Speed / RCF

During run:	current rpm or RCF (after actuation of display switch)
End of run:	"End"
Lid open: (before start)	"OPEN"
Lid open :	"0" with flashing point (rotor not yet recognized)
Error message:	alternating display (if relevant)

Run time

Preselected time :	remaining run time to 0
Continuous: operation (hLd)	run time passed (in hours, minutes)
"Quick run":	run time passed (in minutes, seconds)

Temperature

During run:	current sample temperature in °C at temperature equilibrium)

Keys

Start:	normal start
Stop:	manual stop
Open lid:	open lid (possible only with the instrument switched on)
Quick run:	short-term operation of the centrifuge as long as key remains pressed
rpm/RCF switch:	switching between rpm and RCF display
"set" keys:	stepwise increase/decrease of setpoint values

Short pressing of any of the "set" keys: switch from current to preset value, signaled by flashing display.

Error codes (troubleshooting see chapter "Troubleshooting"):

E-00:	motor blockage
E-03	speed measurement
E-08:	overvoltage; overtemperature in the electronics
E-14:	no rotor or rotor identification impossible
E-17:	lid does not open
rotor:	set speed higher than permissible speed of the rotor
bAL:	unbalance
Lid:	lid opened or popped open during run
OPEN:	with lid closed: safety circuit triggered (drive overheated)

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For your safety

Heraeus centrifuges are manufactured according to current technical standards and regulations. Nonetheless, centrifuges may pose dangers if

- they are not used as designed
- they are operated by untrained personnel
- their design is improperly changed
- the safety instructions are not heeded

Therefore anybody concerned with operation and maintenance of the centrifuge must read and follow the safety instructions.

In addition, the pertinent regulations for prevention of accidents must be strictly followed.

This manual is an integral part of the centrifuge assembly and must be kept close at hand at all times.

Proper use

The centrifuge is designed to separate liquid-suspended materials having different densities and particle size, respectively. The maximum sample density is 1.2 g/cm^3 at maximum speed.

Improper use

During a run, a safety zone of 30 cm around the centrifuge must be maintained where neither persons nor hazardous materials may be stationed.

The centrifuge may cause harm to you or other persons and may damage material goods if you do not respect the following safety measures:

Centrifuging hazardous materials

- The centrifuge is neither made inert, nor is it explosion-proof. Therefore never use the centrifuge in an explosion-prone environment.
- Explosive or flammable substances must not be centrifuged. The same holds for substances prone to react briskly with each other.

- Do not centrifuge toxic or radioactive substances or pathogenic microorganisms unless you have taken proper precautions.

  Such precautions can e.g. consist of biological seals.
- Should toxins or pathogenic substances enter the centrifuge or its parts, you must carry out the proper procedures for disinfection (see "Maintenance and care – Disinfection").
- Strongly corrosive substances that may cause damage to materials and impair the mechanical strength of the rotor may be centrifuged only inside protective vessels.

Handling

- Never use the centrifuge unless the rotor is properly mounted.
- Never manually open the lid if the rotor still turns.
- Use only original parts for the centrifuge. The only exception are common glass or plastic centrifuge tubes if these are approved for the rotor speed and RCF values of your rotor, respectively.
- Never use the centrifuge with the lid open.
- Never use the centrifuge if the paneling has been partially or totally removed.
- Changes in mechanical or electrical components may be carried out only by persons authorized to this effect by KENDRO Laboratory Products.
- You may use the centrifuge only with a properly loaded rotor. You must not overload the rotor.
- If the rotor or the lid shows visible traces of corrosion or wear, you must stop using it.
- Strictly follow the rules and regulations for cleaning and disinfection.

Conformity to current standards

Heraeus centrifuges are manufactured and tested according to the following standards and regulations:

CE

for all voltages:

- IEC 1010-1 / EN 61010-1
- IEC 1010-2 / EN 61010-2-020
  - Pollution degree 2
  - Overvoltage category II

for 120 V only:

- CAN/CSA-C22.2 No. 1010.1-92
- CAN/CSA-C22.2 No. 1010.2.020-94

Safety instructions in this manual

This symbol denotes potential hazards to persons.

This symbol denotes potential damage to the centrifuge or parts in its immediate surroundings.

General hints are marked with this symbol.

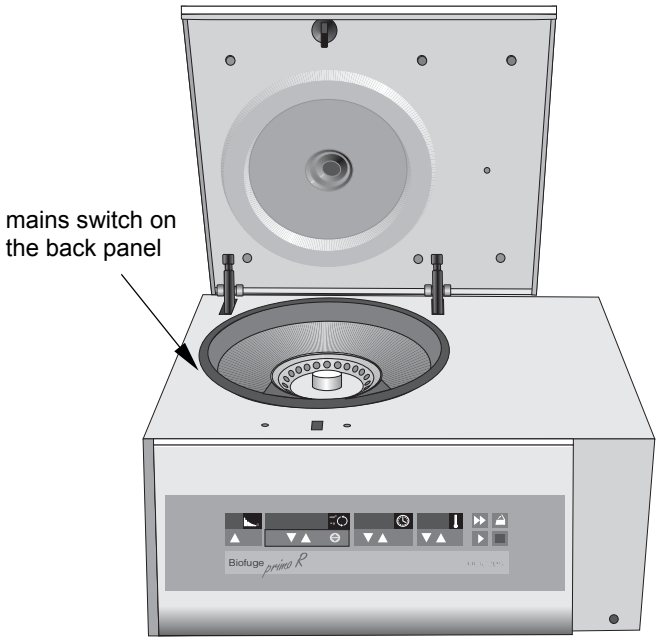
In addition, you are asked to adhere to the pertinent regulations, in Germany

- Regulations for prevention of accidents VBG 4
- Regulations for prevention of accidents VBG 5
- Regulations for prevention of accidents VBG 7z
- Regulations for prevention of accidents VBG 20

for your notes

The *Biofuge primo R*

The figure below shows a general view of the *Biofuge primo R* with open lid and the rotor put into place.



Safety systems

The *Biofuge primo R* is equipped with a number of safety systems:

- Housing and rotor chamber manufactured from sheet steel; inner armoring made of steel, front screen made from impact-resistant plastic
- Lid with window and lid lock

  You can open the centrifuge lid only when the power is turned on and the rotor has come to a halt. You can start the centrifuge only if the lid is properly locked.
- Rotor identification
- Electronic unbalance detection
- Emergency lid release: only in case of emergency, e.g. during power failure (see chapter "Trouble-shooting"

Do not tamper with the safety systems!

Properties

The *Biofuge primo R* is a laboratory centrifuge for use with a variety of rotors and a large number of commercially available centrifuge tubes.

The preset speed is reached in seconds. The maintenance-free induction motor provides quiet and vibration-free operation even at high speeds and warrants an extremely long lifetime.

The user-friendly "Easycontrol" control panel permits easy preselection of speed, RCF value, run time, temperature and run profile (acceleration and braking behavior). You can switch from speed to RCF display or entry and vice versa.

You can change the set values even during a run.

With the "quick run" key (⏩) you can centrifuge a sample for only a few seconds if that is required for your particular task.

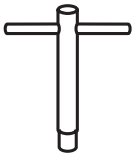
Items delivered

Items delivered with the centrifuge comprise:

– a special cap nut for fixing the rotor

cap nut
order no.
70056208

– 10-mm tubular socket wrench for fastening the cap nut



tubular socket wrench
order no.
2036 0072

– power cord

– short operating instructions

The printed documents consist of the delivery notes and this Manual.

Functions and features

Part / function	Description / feature
design / housing	galvanized sheet chassis with armored shell
tank	stainless steel
drive	induction drive without carbon brushes
key and display board	key and display elements covered by an easy-care protective foil
control	microprocessor-driven by Easycontrol II
main memory	the data last entered remain in memory
functions	RCF preselection, quick run
acceleration and braking profiles	2 acceleration and 8 braking profiles
rotor identification	automatic
unbalance detection	electronic, effective as a function of rotor and speed
lid lock	automatic locking following lid closure

The "Easycontrol" user interface

Function	Feature
lid opening	automatic unlocking via "open lid" key (⏏) (unlocking in case of power failure: see chapter "Troubleshooting")
start	start key (▷)
stop	stop key (■)
"quick run" mode	pressing the "quick run“ key (⏩) actuates maximum acceleration up to the maximum permissible speed; upon key release centrifuge stops with maximum braking power
acceleration / braking profiles	1 = slow acceleration and braking curve 2, 2 ... 9 = fast acceleration and various braking curves (2=weak to 9=strong)
speed selection	adjustable in steps of 10 min^{-1} within the range of 300 min^{-1} to 15000 min^{-1}
RCF selection	upon actuating the switchover key, the RCF value can be entered
run time selection	adjustable in minutes from 1 min to 9 h 59 min; "hLd" mode: permanent operation
run time display in "quick run" mode	between 1 s and 60 s in seconds steps, above in minutes
temperature selection	adjustable in 1 K steps from -9°C to +40°C
end of run	speed display reads "End"

Function	Feature
diagnostic messages	• alternating display "rotor"/maximum speed or RCF (acknowledgment by pressing the start key) • incorrectly closed lid: display "OPEN" • general instrument malfunction (error messages with ERROR codes, see "Troubleshooting"

for your notes

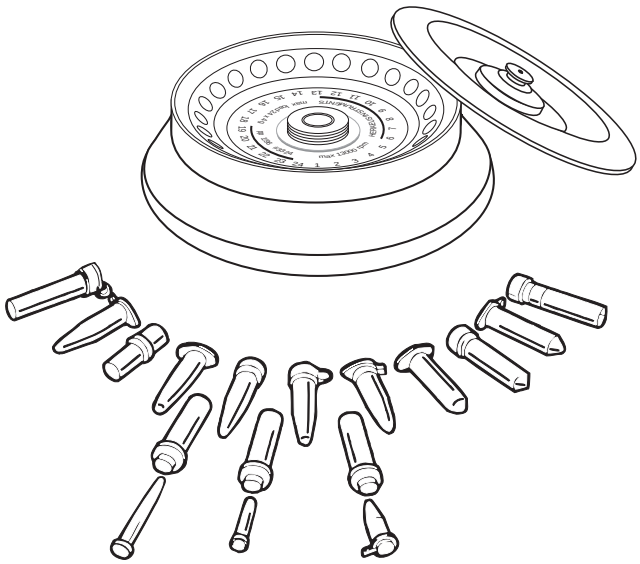
Rotor program and accessories

The *Biofuge primo R* is delivered without rotor!

You may choose from among a large variety of rotors available as accessories.
(see Rotor program, Table 1)

In addition, there are sets of adapters and reduction sleeves for diverse commercially available vessels (see Adapters, Table 2).

Please consult our sales documentation for a complete collection of accessories including technical data and order numbers.



Rotor program

Table 1: Rotor program (1)

Rotor designation	**fixed-angle rotor 6 x 50 ml Falcon**	**swinging bucket rotor 4 x 100**	**swinging bucket rotor 12 x 1.5 / 2.0**
order no.	**7500 7590**	**7500 7591**	**7500 7592**
	buckets and caps see Table 2		
maximum permissible load [g]	6 x 130	4 x 200	12 x 4
maximum speed n_{max} [min^{-1}]	8,500	4,000	13,000
maximum RCF value at n_{max}	10,015	2,525	16,438
radius max./min. [cm]	12.4 / 6.0	14.1 / 5.0	8.7 / 4.7
angle [°]	45	90	90
acceleration/braking time [s]	55 / 36	26 / 21	42 / 42
min. temperature at n_{max} [°C]* * relative to room temperature 23°C	- 1	- 9	4
k factor [S × h]	2.545	16.801	3.690
aerosol-tight	yes (reduced filling)	yes	no
permissible temperature range autoclavable (number of cycles)	– 121 °C; (unlimited)	– no	– no

Rotor program

Table 1: Rotor program (2)

Rotor designation	**microliter rotor 24 x 2 ml aluminum**	**microliter rotor 24 x 2 ml Polypropylene**	**drum rotor**
order no.	**7500 7593**	**7500 7599**	**7500 7595**
maximum permissible load [g]	24 x 4	24 x 4	8 x 80
maximum speed n_{max} [min^{-1}]	15,000	13,000	12,000
maximum RCF value at n_{max}	21,882	16,060	14,005
radius max./min. [cm]	8.7 / 5.9	8.5 / 5.9	8.7 / 3.8
angle [°]	45	40	90 / 60
acceleration/braking time [s]	35 / 22	16 / 20	41 / 33
min. temperature at n_{max} [°C]* * relative to room temperature 23°C	5	-3	4
k factor [S × h]	437	547	1.457
aerosol-tight	yes (reduced filling)	yes (reduced filling)	no
permissible temperature range autoclavable (number of cycles)	– 121°C; (unlimited)	-4 °C to +40 °C 121°C; (10 cycles)	– no

Adapters

Table 2: Adapters (1)

Adapters for fixed-angle rotor 7500 7590	max. vessel size ∅ x length [mm]	number per adapter	number per rotor	color	order no.
1.5 ml microvessels	11 x 57	4	24		7600 2905
3.5 ml	11 x 100	4	24		7500 3091
6.5 ml	13 x 113	2	12		7500 3092
12 ml	16 x 95	2	12		7500 3093
16 ml	18 x 122	1	6		7600 2906
38 ml	25 x 112	1	6		7500 3094
50 ml	29 x 122	1	6		7500 3014
15 ml Falcon	16.5 x 120	1	6		7500 3095
50 ml Falcon	30 x 117	1	6		7500 3096

Adapters for microliter rotor 7500 7593 / 7500 7599	max. vessel size ∅ x length [mm]	vessel capacity [ml]	number per set	color	order no.
reduction sleeve PCR	6.2 x 20	0.2	24	gray	7600 3750
reduction sleeve	8 x 43.5	0.5 / 0.6	24	turquoise	7600 3758
reduction sleeve	6 x 46	0.25 / 0.4	24	red	7600 3759

Table 2: Adapters (2)

Buckets and adapters for swinging bucket rotor 7500 7591	incl. rubber buffer	max. vessel size ∅ x length [mm]	number per adapter	number per rotor	color	order no.
Roundbucket 100 ml/50 ml conical	1807	44 x 100	–	–	–	7500 7555
1.5 / 2 ml micro vessels		11 x 42	10	40	white	7500 7547
7 ml DIN	1818	12 x 102	5	20	white	7500 7545
7 ml DIN blood sampling	1818	13 x 105	3	12	white	7500 7546
15 ml DIN blood sampling	1803	17 x 102	3	12	white	7500 7544
25 ml DIN	1804	25 x 110	1	4	white	7500 7543
50 ml DIN	1805	35 x 105	1	4	white	7500 7542
adapters 50 ml - Falcon		30 x 117	–	–	–	7500 7556
adapters 15 ml - Falcon		16.5 x 120	1	4	white	7500 7557
hermetic caps						7500 7598

The rubber pads 7600 1807 are only to be used for centrifuging 100 ml glass containers.

Remove the rubber pads when using adapters.

Table 2: Adapters (3)

Racks for drum rotor 7500 7595			number per adapter	number per rotor	color	order no.
1.5 ml microvessels			10	80	yellow	7600 1499
1.5 / 2 ml microvessels			10	80	red	7600 1244
1.5 / 2 ml microvessels (60°)			6	48	white	7500 1498
0.3 ml microcapillary vessels			8	64	blue	7600 1246
0.5 / 0.6 ml microvessels			15	120	green	7600 1247
0.25 / 0.4 ml microvessels			20	160	yellow	7600 1248

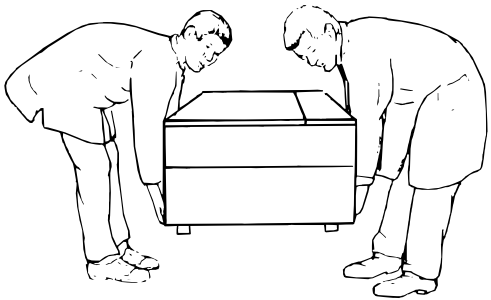
Before use

Transport and installation

The centrifuge is delivered in an special box. Cut it open and remove the protective material.

When transporting the centrifuge, consider its weight (see Technical Data); always grab it on both sides taking care that enough helpers are around (see Figure).

Do not lift by the front panel!



Damage to the centrifuge by jolting during transport and sudden dropping!

Transport the centrifuge only in the upright position using the special box provided with the instrument, and secure it properly. Place the centrifuge carefully.

Proper location

The centrifuge may only be used indoors. Its location must meet the following criteria:

- A safety zone of at least 30 cm around the centrifuge must be maintained where hazardous materials may not be kept during centrifugation.
- The substructure must be stable and resonance-free. A good support is provided by a plane laboratory bench or a large laboratory carriage with lockable casters.
- To ensure sufficient air circulation, a minimum distance from the wall of 10 cm at the back and of 15 cm on each side must be kept.

- The centrifuge must be protected from heat and direct sunshine.
- The location must be well ventilated at all times.

Positioning the instrument

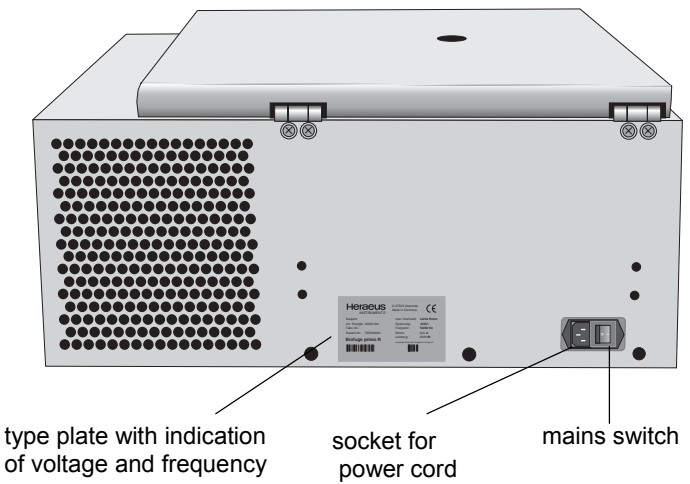
Following a relocation, the centrifuge must always be properly aligned with the adjustable bases.

Make sure the bases are evenly weighted.

Mains connection

Connect the centrifuge only to an earthed mains supply. Make sure that the cable is compatible with the safety regulations valid in your country, and that your mains voltage and frequency correspond to the specifications on the instrument label.

Turn the mains switch on the back panel off (press "0"); only then connect the centrifuge with the mains supply via the power cord.



Operation

Switching on the centrifuge

Turn on the mains switch on the back of the instrument.

For a couple of seconds the following reading appears in the control panel:

This tells you that the instrument carries out an internal check of its software (see table on page 54).

After this check the display switches to the actual values. The values for the remaining run time and speed both read 0. The display of the acceleration/braking curve depends on the value last set.

The following figure gives an example of possible readings. A detailed description of possible settings is given below in this chapter.

Lid operation

Opening the lid

Press the "open lid" key ⏏.

If the message "Lift Lid" appears, you must lift the lid slightly.

(Emergency release in case of malfunction or power failure: see chapter "Troubleshooting".)

Closing the lid

The centrifuge is closed by slightly pressing down the front part of the lid.

☞ **Do not slam the lid shut!**

Inserting the rotor

Improper or improperly combined accessories may cause severe damage to the centrifuge!

The rotors approved for the *Biofuge primo R* are detailed in the chapter "Rotor program and accessories". Use only rotors with this instrument that are contained in this list.

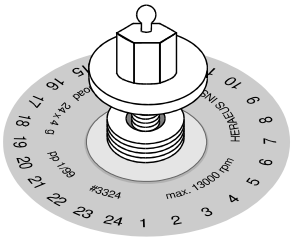
To insert the rotor, you need the cap nut and the tubular socket wrench supplied (see chapter "The Biofuge primo R – Items delivered".

Possible damage to drive and rotor!

You may insert the rotor only if the temperature of the drive, the rotor and the cap nut is between 10 °C and 30 °C.

Proceed as follows:

1. Open the lid and make sure that the rotor chamber and the rotor are clean. Remove eventual dust, foreign material or sample residues. The thread and the O-Ring on the motor shaft must be in perfect condition.
2. Turn the rotor so that the notch for engaging the drive shaft points downward.
3. Place the rotor on top of the drive shaft so that the notch of the rotor is located precisely above the retaining pin.
4. Push the rotor gently down until the thread is completely laid bare (see figure).



5. If you have placed the rotor correctly, you can screw on the cap nut easily and secure it with the tubular socket wrench delivered with the instrument.
6. Place the rotor cap onto the rotor.

Do not push the rotor down using force. If you cannot screw on the cap nut, you must carefully lift off the rotor and insert it again.

Regularly check the proper positioning of the rotor and re-tighten the cap nut as needed.

Handling of rotors and seals

The swiveling pegs of the swinging bucket rotors and the corresponding notches of the buckets must be lightly greased.

(Lubricant 7600 3500 is delivered with the rotor.)

The O rings in the rotors and rotor lids as well as the O ring in the hermetic cap 7500 7598 for the 100-ml / 50-ml buckets must likewise be lightly greased.

Use only the special lubricant 7600 3500 for greasing the O rings!

You must replace damaged O rings!

Replacements parts are delivered with the rotor or can be ordered separately as spare part package.

– 7500 3404 for the rotor 7500 7593

– 7500 3423 for the rotor 7500 7590

Important application information for rotor 7500 7599!

To attach the rotor, use the acorn nut with ball head!

(Order no. 70056208)

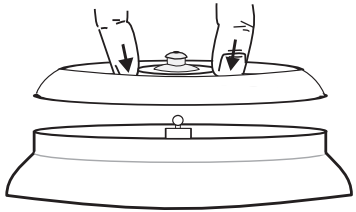
To tighten the acorn nut, use the 10 mm tubular hexagon box spanner.

(Order no. 20360072)

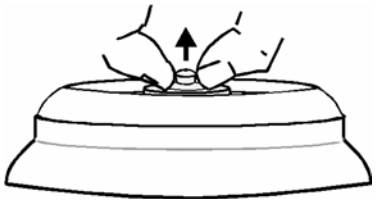
Please always close your microlitre containers carefully. Open container lids can damage the rotor lid.

For some special applications the container lids must remain unsealed. If this is the case, please use the screw top (order no. 75003326) instead of the standard snap-on lid (order no. 70901111).

A) Position the snap-on lid.
Press the rotor lid down onto the rotor until the snap-on catch engages onto the ball of the acorn nut.



B) Remove the snap-on lid.
By activating the grip cap, the lock is released and the rotor lid can be removed.

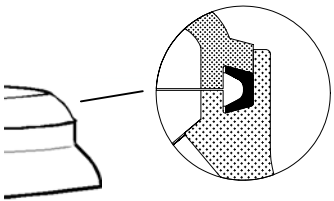


Aerosol-tight application

only with screw-on top 75003326 and not with open container lids!

The following steps have to be carried out:

- Lubricate the seals before inserting them (lubricant order no. 75003500)
- Insert the seal (C profile) in the groove at the side of the body of the rotor.
- Insert the O-ring into the inner groove on the screw-on top.



Attention :

Please check that your sample containers are suitable for the centrifugal application desired.

(16060 x g ; temperature in uncooled devices approx. 10 K above room temperature)

Please observe the permissible filling volumes!

Nominal volume:		Permissible volume:
2.0 ml	-	1.5 ml
1.5 ml	-	1.0 ml
others	-	$^2/_3$ nominal volume

The sealing elements are to be checked regularly for damage to the shape and surface!
Exchange faulty parts immediately (spare sealing rings 75003268)

The snap-on lid is not suitable for aerosol-tight application!

Permissible rotor temperature

The rotor 7500 7599 may be used only within a temperature range of -4 °C to +40 °C. Pre-cooling in the freezer is not permitted.

Lifetime of the rotor

There are no restrictions to the service life of the high performance rotor 7500 3325 B. However please observe the following due to safety reasons:

Rotors and accessories made of plastic should not be exposed to direct sunlight and UV rays!

If the rotor shows signs of discoloration, deformation or wear, or is out of balance it must be exchanged straight away!

Loading the rotor

Maximum loading

Overloading may cause the rotor to explode! Exploding parts may severely damage the centrifuge!

The *Biofuge primo R* can reach high rotational speeds implying enormous centrifugal force. The rotors are designed in a way warranting sufficient residual strength even at the highest permissible speed.

However, this safety system presupposes that the maximum permissible load of the rotor is not exceeded.

If you wish to centrifuge samples that together with the adapters exceed the maximum permissible load, you must either reduce the sample volume or calculate the permissible speed n_{perm} according to the following formula:

$$n_{perm} = n_{\max} * \sqrt{\frac{maximum\ permissible\ load}{actual\ \ load}}$$

Filling the centrifuge tubes

Check carefully whether your sample vessels are permissible for the respective *g* value, and reduce the speed if necessary.

The smaller the unbalance of the centrifuge, the better the separation since separated zones are no longer perturbed by vibration. It is therefore important to balance the centrifuge tubes as well as possible.

Please note that the lifetime of plastic tubes, particularly at the highest permissible load (speed, temperature), is limited; they must be replaced if worn!

Loading instruction for rotors 7590 and 7595

You must always equip all sample locations with adapters or sample racks!

The rotor 7590 may only be used with the lid in place.

Loading for aerosol-tight operation

For the centrifugation of hazardous samples you must always respect the highest permissible sample amounts.

Aerosol-tight operation presupposes that sample vessels are properly filled and the rotor lid is correctly closed.

The vessels may generally be filled only to a point where the sample cannot reach the vessel rim during centrifugation. For the most commonly used vessels, the maximum allowed volumes are listed in the table on page 29.

For the fixed-angle rotors you should use the special hexagon screw driver for tightening (and loosening) the lid in order to safeguard proper closure (push through the bore of the screw-on lid.)

Rotor	vessel type / maximum filling volume					leakage test
microliter rotor 24 x 1.5 ml #7593	Reakt 1.5 ml **1.0 ml**	Reakt 2.0 ml **1.5 ml**				**8 ml**
microliter rotor 24 x 2.0 ml #7599	Reakt 1.5 ml **1.0 ml**	Reakt 2.0 ml **1.5 ml**				**8 ml**
fixed-angle rotor 6 x 50 ml #7590	Falcon 50 ml **49 ml**	Falcon 15 ml **14 ml**				*
swinging bucket rotor #7591	Glas 100 ml **80 ml**	Glas 50 ml **45 ml**				

***) Vessel filled to the brim, lid screwed on lightly**

- Reakt – reaction vessel
- Falcon – bucket type Falcon
- Glas – glass vessel

Checking for aerosol tightness

Check the aerosol tightness of your rotor whenever appropriate.

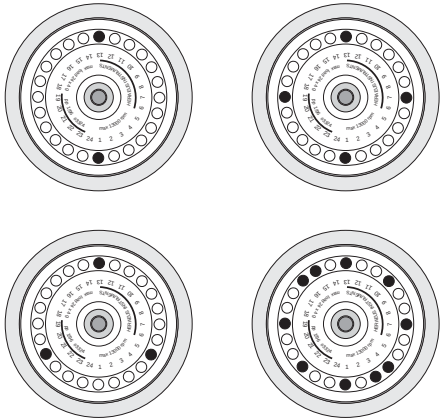
Since you cannot yourself carry out the check with the swinging bucket rotor #7591, you should monitor seals, sealing surfaces and screw caps particularly carefully in this case!

To carry out the test, proceed as follows:

- Carefully clean and degrease the rotor chamber wall, then attach an adhesive white paper strip (about 4 x 2 cm) so that liquid leaking out of the rotor may precipitate on it.
- Fill all places of the respective rotor with water according to the following Table. Insert the rotor into the centrifuge and fasten it.
- Carefully place the amount of test liquid (0.5 % sodium fluorescein in water) specified in the column “leakage test” into the lower part of the rotor within a virtual circle comprising the vessel bores (not the bores themselves) using a pipette or syringe.
- Place the rotor lid on top and screw it on.
  ATTENTION: Make sure that there is no spilled test liquid on the rotor (clean if necessary)!
- Carry out a test run for 10 minutes at maximum rotor speed and 23 °C ambient temperature.
- Check the paper strip under UV light (preferentially in a darkened room):
  If there is no detectable fluorescence, the test is considered passed.
- Finally rinse rotor, rotor lid and lid seal in running water and allow to dry.

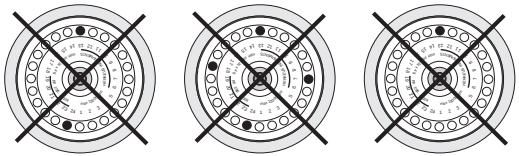
Placing the tubes in the rotor

The rotor must be loaded symmetrically. When loading the rotor only partially, you must ensure that opposite bores always receive tubes of equal weight (when centrifuging a single sample, place a centrifuge tube e.g. filled with water opposite). The following figure gives examples for proper loading.



proper loading

Uneven loading can in the extreme case lead to actuation of the unbalance detection. Unbalance not only causes a noisy run, but also rapidly damages the drive.



wrong loading

These examples are to be applied to the other rotors in an analogous manner!

After placing the tubes, close the rotor lid.

Entering parameters

Braking curves

The *Biofuge primo R* offers a total of 9 running profiles for optimally centrifuging samples and gradients. Please consult the diagram examples in the Appendix for a closer look at the acceleration and braking curves (for rotors not mentioned there you may extrapolate the respective values).

After switching the centrifuge on, the centrifugation profiles last entered are preselected.

By pressing the "set" key △ you can switch through the subsequent profiles until the desired profile is reached.

Once the display stops flashing, the value is stored in memory and remains unchanged until changed by a new entry.

Switching from speed to RCF display and vice versa

Upon turning the centrifuge on, the speed display is the default setting.

Use the speed/RCF display switch to choose between speed and RCF entry or display.

Selecting the speed

The centrifuge can be set to a minimum of 300 and a maximum of 15,000 min^{-1} (depending on the rotor).

You can adjust the speed in steps of 10 min^{-1}. Proceed as follows:

1. By pressing once one of the "set" keys △ (for an increase) or ▽ (for a decrease) in the "speed" section of the control panel, you switch from actual to setpoint values. The value last stored is displayed, with the digit to be entered flashing (if there is no value stored in memory, this is indicated by dashes -----).
2. By **briefly** pressing the input key you can now raise or lower the speed by one step (10 min^{-1}).

3. If you keep the key pressed, the display changes at first slowly and after a few seconds at an accelerated pace.
4. Release the key as soon as you have reached the desired value, and fine tune if necessary by repeatedly pressing the key. The decimal place flashes for

a number of seconds, then changes to permanent display. The speed is now stored.

5. For faster operation, you may shift the flashing cursor in the speed/RCF and in the run time panels: just press both △ and ▽ simultaneously. The cursor moves by one digit to the left for each key depression.

Entering the RCF value

You can adjust the RCF setpoint in steps of 1. The setpoint is entered analogously to the speed.

As long as the rotor has not been identified, it is impossible to display RCF values. This is signaled by dashes ----- in the display.

Shortly after starting the centrifuge run the rotor is identified, and the current value is displayed.

NOTE:

If you set an extremely low RCF value, this may be automatically corrected if the resulting speed would be lower than 300 rpm.

Concerning the RCF value

The **r**elative **c**entrifugal **f**orce (RCF) is given in multiples of the earth gravity *g*. It is a dimensionless number that allows one to compare the efficiency of separation or sedimentation of diverse instruments, since it is independent of the instrument used. The only values entered in the equation are radius and speed of centrifugation:

$$RCF = 11.18 * \left(\frac{n}{1000}\right)^2 * r$$

r = radius of centrifugation in cm

n = speed in rpm

The maximum RCF value is based on the maximum radius of the vessel bore.

Please note that this value becomes lower depending on the tubes and adapters used.

You may take this into account when calculating the RCF value for your application.

Selecting the run time

You can select a run time between 1 min and 9 h 59 min or continuous operation (hLd).

Preselected run time

To set a fixed run time, proceed as follows:

1. Press one of the "set" keys △ (for an increase) or ▽ (for a decrease) in the "time" section of the control panel once to switch from the actual to the set-point mode.
2. By **briefly** pressing the input key you can now raise or lower the run time in 1-minute steps.

3. If you keep the selected key pressed, the display changes at first slowly and after a few seconds at an accelerated pace.
4. Release the key as soon as you have reached the desired value, and fine tune if necessary by repeatedly pressing the key.

   The minute display flashes for a number of seconds, then changes to permanent display. The run time is now stored.

You may shift the flashing cursor to set the value as described under "Selecting the speed".

Continuous operation

To switch the *Biofuge primo R* to the continuous mode, you must press the key ▽ until the display reads "hLd".

With this setting, the centrifuge keeps running until stopped manually.

Selecting the temperature

You can preselect the temperature in the range of -9 °C to +40 °C.

(Please consult the standard diagram in the Appendix to obtain the attainable values.)

To adjust the temperature, proceed as follows:

1. Press one of the "set" keys ▲ (for an increase) or ▼ (for a decrease) in the "temperature" section of the control panel once to switch from the actual to the setpoint mode.
2. By **briefly** pressing the input key you can now raise or lower the temperature in 1-K steps.

3. If you keep the selected key pressed, the display changes at first slowly and after a few seconds at an accelerated pace.
4. Release the key as soon as you have reached the desired value, and fine tune if necessary by repeatedly pressing the key.

The temperature display flashes for a number of seconds, then changes to the current value display. The temperature setpoint is now stored.

Starting the centrifuge

Once the rotor is properly placed, the mains switch is turned on and the lid is closed, you can start the centrifuge.

Press the "start" key ▷ in the control panel. The centrifuge accelerates to the preselected value. Simultaneously, the run time display starts going backward from the preset time, at first giving the remaining run time in minutes and upon reaching the last minute in seconds (in continuous operation the time display goes forward).

If a value exceeding the maximum permissible speed or RCF of the respective rotor was entered, this is indicated after the start of the centrifuge by the alternately flashing messages "rotor" and the maximum permissible value for the inserted rotor.

Within 15 seconds you may adopt this value by again pressing the "start" key; the centrifugation is then continued. Otherwise the centrifuge stops, and you must enter a permissible value.

You cannot open the lid during the run.

Unbalance detection

In case there is an unbalance in the rotor, this is indicated at a speed slightly exceeding approximately 300 rpm by the message "bAL".

The run is terminated, and you may restart the centrifuge after correcting the error (check loading).

Changing the settings during the run

You can change all settings during a run. By pressing once any one of the "set" keys in the control panel you can switch from the actual to the setpoint mode.

The setting to be adjusted flashes and can then be altered. Once the data input is finished and the display has changed to the actual value display mode, the new settings become operative.

Stopping the centrifuge

Stopping with preset time

Normally the run time has been preselected, and all you have to do is wait until the centrifuge terminates the run automatically at the end of the preset time.

As soon as the speed is down to zero, the display reads "End". You can now open the centrifuge by pressing the "open lid" key and remove your samples.

You can manually stop the centrifuge at any time by pressing the "stop“ key .

At this point the remaining run time is displayed.

Stopping with continuous operation

If you have chosen continuous operation, you must stop the centrifuge manually. Press the "stop" key in the control panel. The centrifuge starts braking with the preset braking profile. The display reads "End", and you can open the lid by pressing the "open lid" key and remove your samples.

Temperature regulation at rest

The precise control becomes active once the rotor has been identified; the speed panel then displays "End".

If the rotor has not been identified (lid has been closed and the "start" key has not yet been pressed, speed panel reads "0" with flashing point), the instrument regulates the temperature so that the samples cannot freeze in any one of the usable rotors.

If you find the systematic deviation of up to 4 K bothersome, you must start the rotor for a short period until it is identified.

Short-time centrifugation

For short-term operation, the *Biofuge primo R* is equipped with a "quick run" function.

Short-term centrifugation is started by pressing the "quick run" key ⏩ continuously; it stops as soon as the key is released.

In this mode the centrifuge accelerates with full power up to the maximum speed. The preset speed or RCF is ignored in this case.

Depending on the rotor, the centrifuge accelerates to the maximum speed!

Check carefully whether you have to maintain a specific speed for your application.

During acceleration the time is counted forward in seconds. The display remains until the centrifuge lid is opened.

Removing the rotor

To remove the rotor, you must follow the steps described for insertion in reverse order.

Grab rotor with both hands and pull upwards perpendicularly.

1. Open the centrifuge lid.
2. Remove the rotor lid.
3. Unscrew the cap nut by turning it counterclockwise using the socket wrench supplied, and remove the cap nut.
4. Grab the rotor with both hands and lift it carefully off the drive shaft. Make sure not to tilt it.

When using an aerosol-tight lid, you may in case of contamination separate the pertinent rotors from the drive shaft without opening the lid!

In this case you can e.g. open and decontaminate the dismantled rotor using a safety work bench.

Maintenance and care

Maintenance operations to be carried out by the customer

For the protection of persons, the environment and the equipment you are obliged to clean the centrifuge regularly and to disinfect it if necessary.

Unsuitable cleaning agents or disinfection procedures may damage the centrifuge and its parts!

For cleaning and disinfection use only the cleaning and disinfection procedures detailed in this manual.

Cleaning

Pull mains plug before cleaning the instrument!

The main care is to clean regularly (or as need arises) the housing, the rotor chamber, the rotor and the accessories. This is indicated both for reasons of hygiene and to prevent corrosion due to contamination sticking to the instrument and its accessories.

For cleaning you should only use agents approved by KENDRO:

- Caraform
- deconex 16 NT
- Extran MA 02 neutral
- RBS neutral

For all other cleaning agents please consult our Service Department!

Organic solvents decompose the lubricant of the motor bearing. The drive shaft may jam.

Liquids and especially organic solvents must not come into contact with the drive shaft and the ball bearing during cleaning.

If an ice sheet was present in the inner chamber, make sure to remove the water formed during defrosting.

Disinfection

Infectious material may enter the centrifuge if the vessel fractures or in the case of spillage.
Risk of infection if touched!

Note the permitted filling volumes!

In the event of contamination, the user must ensure that no third parties are in danger!
Parts affected must be decontaminated immediately.

Note the personnel safety measures!

If necessary, further safety measures must be taken.

If a centrifuge tube containing infectious material becomes leaky or breaks during a run, you must immediately disinfect the centrifuge. In doing this, you must heed the following points:

- To decontaminate the affected rotor chamber and rotor, use only disinfectants approved by KENDRO. These agents are to be used according to the Instructions for Use supplied with the respective disinfectant:

– Aldasan 2000
– Carlitt Spray
– Coldspore
– Gigasept FF
– HBV Pump-Spray
– Incidin Liquid Spray
– Incidur Spray
– Incidin plus
– Kohrsolin iD
– Lysetol FF
– Lysoform
– Lysoformin 3000
– Sagromed
– Sagrotan

For all other disinfectants please consult our Service Department!

- You may disinfect the rotor and the accessories as described in the following section. Be sure to follow the pertinent safety procedures for handling infectious material.

1. Pull the mains plug.
2. Unscrew the rotor seat.
3. Grab the rotor with both hands and pull it perpendicularly off the drive shaft.
4. Remove the centrifuge tubes and adapters, and disinfect them or dispose of them as necessary.
5. Treat the rotor and the rotor lid according to the instructions given for the disinfectant in question (soaking in liquid or spraying). You must strictly observe the specified reaction times!
6. Turn the rotor head down and drain it. Thoroughly rinse rotor and lid with water.
7. Dispose of the disinfectant solution as required by the respective valid regulations.
8. Aluminum rotors must subsequently be treated with anticorrosive grease.

Disinfection with eau de Javelle

These bleaching agents contain extremely aggressive hypochlorite solutions and may in no case be used with aluminium rotors. To protect the rotor 75007599 as far as possible you must take the following precautions:

1. Avoid high temperatures!
   The bleaching solution and the rotor should not be warmer than ca. 25 °C.
2. Do not let the bleaching solution act longer than absolutely necessary!
3. After disinfection, rinse the rotor thoroughly with distilled water and allow to dry.

Autoclaving

Check whether autoclaving is permitted!

(See note in Table 1 starting on page 14 and labels on rotor body and rotor lid.)

You may autoclave the rotor and the adapters at 121 °C.

Maximum permissible autoclaving cycle: 20 min at 121 °C.

For reasons of safety you may autoclave the rotor 7500 7599 maximally 10 times!

The rotor must be cleaned and rinsed with distilled water before being autoclaved. Remove the rotor lid, the centrifuge tubes and the adapters. Place plastic rotors on an even surface to avoid deformation.

Chemical additives to the steam are not permitted.

Never exceed the maximum permissible values for autoclaving temperature and autoclaving time.

Should the rotor show signs of wear, you must stop using it!

The Service of KENDRO

Kendro Laboratory Products GmbH recommends annual servicing of the centrifuge and the accessories by the authorized service or skilled personnel. The service provided by KENDRO comprises checking:

- the electrical installation
- the suitability of the location
- the lid lock mechanism and the safety circuit
- the rotor
- the rotor fastening and the drive shaft

Defective parts are exchanged. Besides, the service personnel cleans the rotor chamber.

KENDRO offers inspection and service contracts covering these benefits. Inspection costs are charged as flat-rate contracts.

Necessary repairs are carried out free of cost during the warranty period, and against payment after expiration of the warranty.

Warranty conditions

The warranty period starts with the day of delivery. Within the warranty period the centrifuge is repaired or replaced free of cost if there are demonstrable faults in materials or workmanship.

Conditions for a warranty are that:

- the centrifuge is used according to the instructions of use
- installation, additions, adjustments, changes or repairs are carried out exclusively by personnel authorized for this by KENDRO
- the required maintenance and care procedures are carried out regularly.

for your notes

Troubleshooting

Emergency lid release

In case of a power failure you cannot open the lid normally using the normal electrical lid unlocking mechanism. To permit unloading even in this case, the centrifuge is equipped with a manual lid unlocking system. However, you may use this system **only** in case of emergency.

Rotor can spin at high speed! Touching it may cause severe injuries!

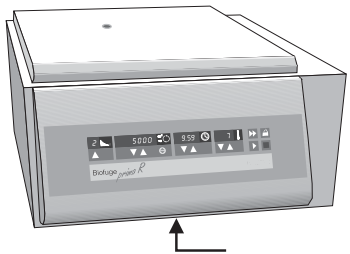
Always wait for several minutes until the rotor has come to a complete stop. Without power the brake does not function, and braking takes much longer than normal!

Proceed as follows:

1. Make sure that the rotor stands still (consult window in the lid).

Never brake the rotor using your hands or tools!

2. Unplug the mains plug.
3. Near the front panel of the housing there is a plastic plug underneath the instrument that you can pry out of the bottom plate using a screw driver or a knife. By suddenly pulling the attached rip cord you can activate the mechanical lid unlocking mechanism. The lid opens, and you can remove your samples.



4. Finally, push the rip cord back into the instrument and close the opening with the plastic plug.

Once the power is back, you can connect the instrument to the mains supply and turn it on.

Problems you can handle yourself

If problems other than those described in the following tables arise, you must consult the authorized service.

Error	Behavior of the centrifuge	Possible causes and corrective measures
Displays remain dark	The motor stops. The rotor stops without braking. The lid cannot be opened.	**Mains failure or not connected.** 1. Is the mains switch turned on? 2. Check the mains connection. 3. If the mains connection is OK, call the nearest Service.
Displays fail briefly.	The motor stops suddenly. The rotor stops without braking. The display reads E-14.	**Brief interruption of mains supply.** 1. Turn off mains switch. 2. Check whether the plug is plugged in properly. 3. Restart the centrifuge.

Error	Behavior of the centrifuge	Possible causes and corrective measures
Lid cannot be opened.	Pressing the "open lid" key has no effect.	**Lid not correctly engaged or lid warped.** 1. Check whether mains connection is OK and the instrument switched on (displays lit). 2. Press lid down in the middle of the front section once, and actuate the "open lid" key anew. (Each additional actuation of "open lid" key requires a waiting time of about 4 seconds.) 3. If this is unsuccessful, you may open the lid using the emergency lid release (see page 45).
–	Centrifuge is exceptionally noisy.	1. Stop the centrifuge by pressing the "stop" key ■, in case of emergency pull mains plug. 2. Wait until the centrifuge stands still. 3. Check whether the rotor is properly loaded. 4. Check whether a broken vessel, damage to the rotor or motor malfunction was responsible for the noise. If you cannot locate and solve the problem, call Service.

Error	Behavior of the centrifuge	Possible causes and corrective measures
Message "bAl" appears in display.	Rotor stops without braking.	**Unbalance switch actuated.** 1. Open the instrument by pressing "open lid" key .. 2. Check whether the rotor is properly loaded. 3. Check whether a broken vessel or damage to the rotor was responsible for unbalance switch actuation.
Message "rotor" appears in display.	Rotor decelerates with brake on following a pause.	**Set speed exceeds permissible maximum speed for the rotor in question.** (The same holds for RCF setting.) A) For about 15 sec. the display shows alternately "rotor" and the maximum permissible speed or RCF for the inserted rotor. Within this period, it is possible to adopt this value by again pressing the "start" key. The centrifugation is then continued. B) Following onset of braking you must wait until the rotor has stopped. By opening and closing the lid you can reset the message "rotor". After entering a permissible speed you can start anew.
Display "OPEN" appears although lid is closed.	Start impossible.	**Lid not properly closed.** Open the lid and repeat locking procedure.

Error	Behavior of the centrifuge	Possible causes and corrective measures
Message "Lid" appears in the display.	Drive stops. Rotor coasts to rest.	**Lid was opened manually during the run.** 1. Press the lid shut again. The instrument stops without braking. 2. If you want to continue the run, you must switch the instrument off and on again.
E-00	Motor does not start.	**Motor or rotor blocked.** 1. Switch instrument off and on again using the mains switch. 2. Open the lid. 3. Check whether the rotor can turn freely. If you cannot thus relieve the malfunction, call our Service.
E-02	Rotor stops without braking to standstill. Instrument cannot be operated.	**Internal program error in memory.** Switch the instrument off and on again. If the error persists, call our Service.
E-03	Rotor stops without braking to standstill. Instrument cannot be operated.	**Error in speed measurement.** Switch the instrument off and on again. If the error persists, call our Service.

Error	Behavior of the centrifuge	Possible causes and corrective measures
E-04	Rotor stops without braking to standstill. Instrument cannot be operated.	**Temperature measurement impaired** (probe breakage). Switch the instrument off and on again. If the error persists, call our Service.
E-06	Rotor stops without braking to standstill. Instrument cannot be operated.	**Communication error between keyboard and main processor.** Switch the instrument off and on again. If the error persists, call our Service.
E-07	Rotor stops without braking to standstill. Lid can be opened.	**Overtemperature in the tank.** Display > 51°C or measured temperature > 70°C . (Possibly refrigeration unit defective)
E-08	Rotor stops without braking to standstill. Instrument cannot be operated.	**Overvoltage at the U/F converter.** Mains voltage outside tolerance. Brake resistance defective. Call Service if trouble persists

Error	Behavior of the centrifuge	Possible causes and corrective measures
E-10	During self test after switching on.	**NV-RAM; error in program memory.** Switch the instrument off and on again. If the problem persists, call Service.
E-12	Rotor stops without braking to standstill. Instrument cannot be operated.	**Temperature measurement impaired.** Switch the instrument off and on again. If the problem persists, call Service.
E-14	Instrument does not start or brakes to standstill.	**No rotor present or rotor identification impossible.** A) Check whether a certified rotor is inserted. B) Following a brief power failure, the rotor could not be identified. Switch the instrument off and on again using the mains switch.
E-15	Rotor stops without braking to standstill. Instrument cannot be operated.	**Check sum in NV-RAM wrong.**

Error	Behavior of the centrifuge	Possible causes and corrective measures
E-17	Lid does not open.	**Lid blocked or jammed.** Press the front part of the lid centrally down once, and press the "open lid" key anew. Otherwise see "Emergency lid release" (page 45)
E-19	During self test after switching on.	**Wrong NV-RAM or keyboard.**
E-22	During self test after switching on.	**NV-RAM parameter incompatible with processor**
E-24	During self test after switching on.	**NV-RAM 2 absent.**
E-25	Rotor stops without braking to standstill.	**Start without rotor.** 1. Turn instrument off and on again. 2. Open the instrument by pressing the "Open lid" key .. 3. Check whether the rotor is loaded and placed correctly. 4. Check whether a broken vessel or a damaged rotor was responsible for actuating the unbalance switch. If the error persists, call Service.

In case you must call the Service

Should you need our Service, please tell us the order no. and serial number of your instrument. You find the pertinent information at the back of the instrument near the socket for the mains plug.

Moreover it is helpful for our service technician to know the software version. You can determine the software version as follows:

1. Switch the instrument off.
2. Switch the instrument on.

   All displays read 8.88888… for about one second.

   Subsequently, the display may show e.g. the following readings for 2 seconds each:

Software version keyboard	__591	__2
Software version	__590	__6
NV-RAM version 1	_2571	__7
NV-RAM version 2	_2572	__2

The values in the time panel give the development stage.

The last information displayed is the current cycle status.

Cycle counter	__235	_CY

The values given are only examples!

During the subsequent program test, the message _ TEST PRO 9 ... 0 is displayed.

Technical data

Function/parameter	Value
environmental conditions	- indoor use - max. elevation 2000 m above sea level - max. relative humidity 80 % up to 31 °C; linearly decreasing down to 50 % relative humidity at 40 °C.
permissible temperature of the environment	+2 °C to +40 °C
run time	1 min - 9 h 59 min, hold = permanent operation
maximum speed n_{max}	15,000 min^{-1} (rotor-dependent, adjustable in steps of 10)
minimum speed n_{min}	300 min^{-1}
maximum RCF value at n_{max}	21,885
maximum kinetic energy	<10 kNm
noise at maximum speed	< 60 dB (A)
set temperature range	-9 °C to +40 °C
dimensions (H x W x D)	313 mm x 580 mm x 493 mm
weight without rotor	69.5 kg

Function/parameter	Value
compliance with standards	Manufactured and checked in accordance with EN 61 010-1, EN 61 010-2-020, EN 50 081-1, EN 50 082-1.

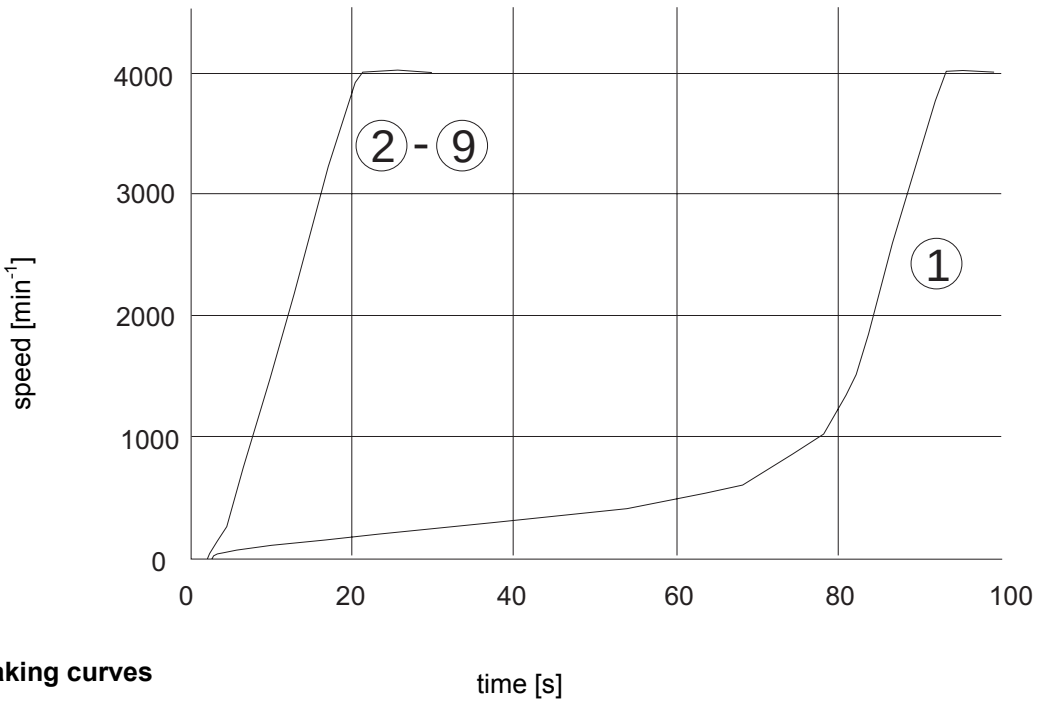
Electrical connections/fuses

Order no.	Voltage	Frequency	Nominal current	Power consumption	Fuse protection of instrument	Fuse protection of building
7500 5440	230 V	50 / 60 Hz	2.9 A	490 W	4.0 A	10 AT
7500 5441	120 V	60 Hz	7.4 A	680 W	8.0 A	10 AT

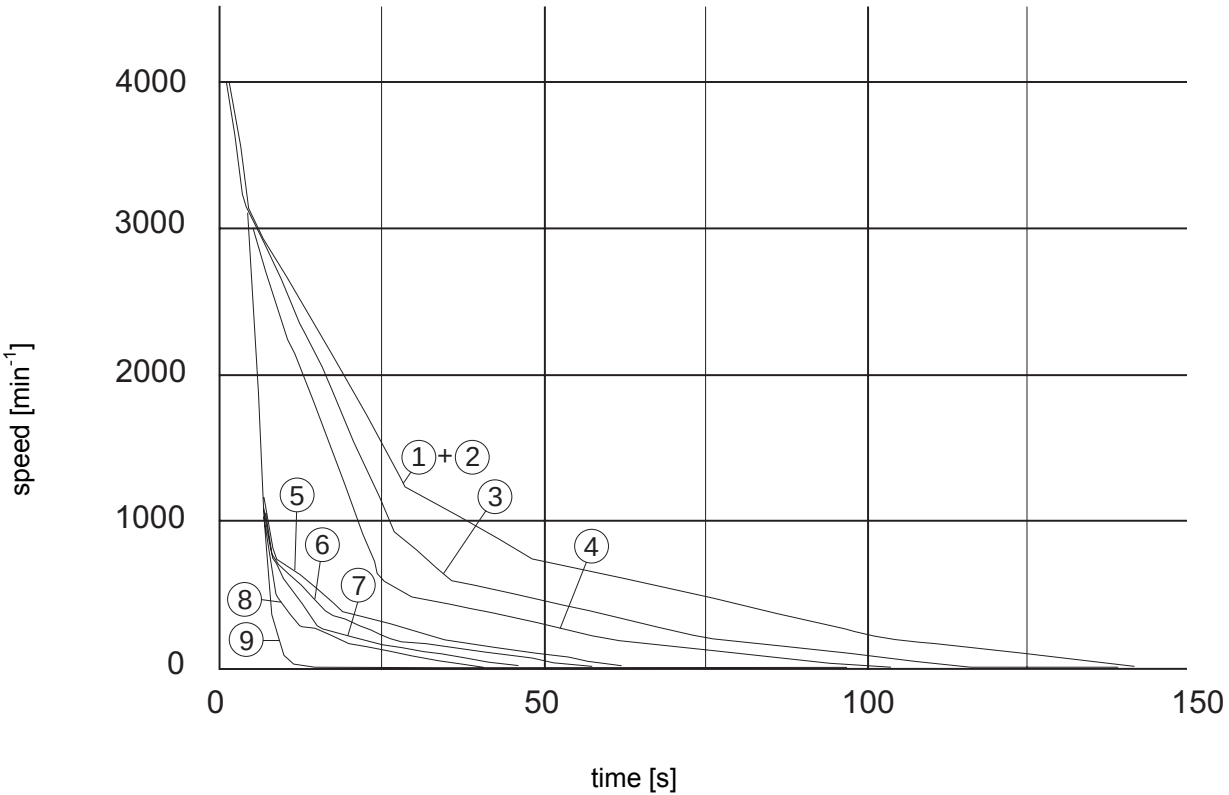
Appendix

Braking and acceleration curves

Acceleration curves

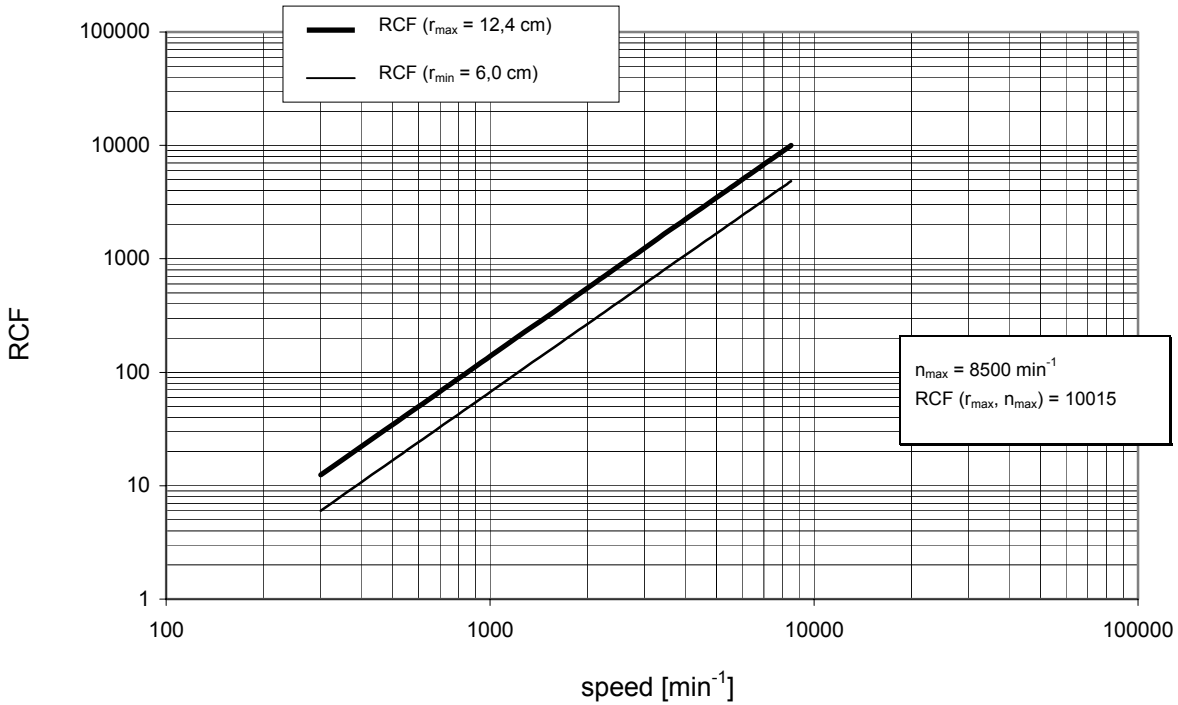


Braking curves

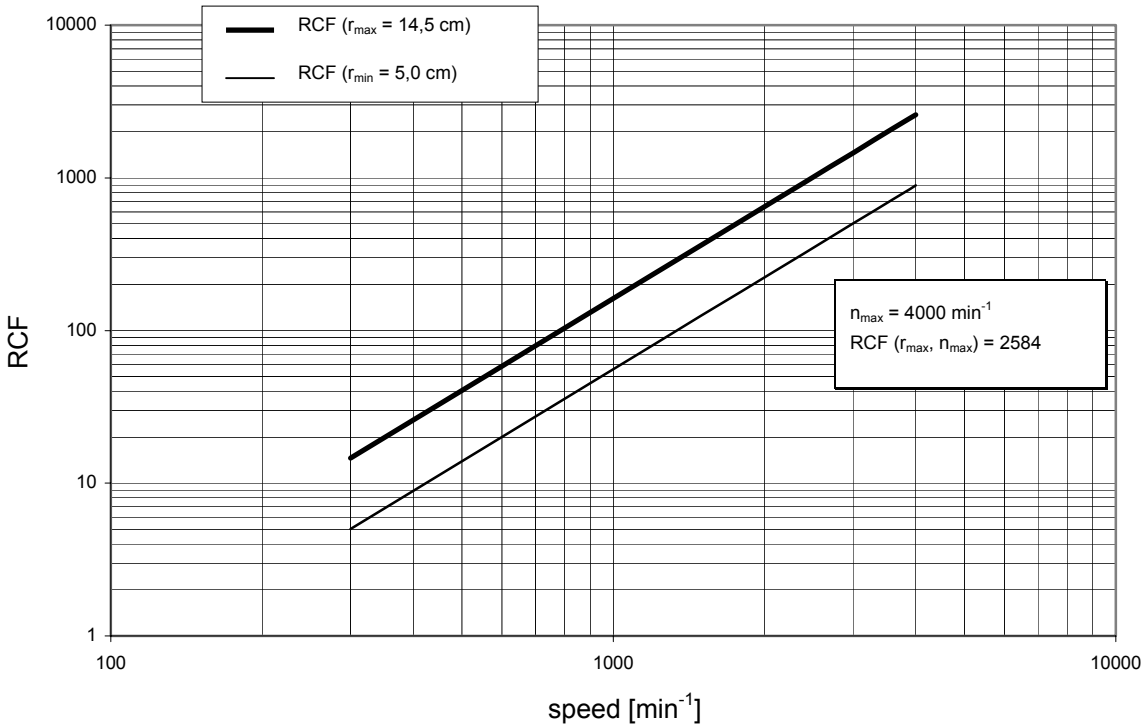

4000
3000
2000
1000
0
speed [min-1]
0
50
100
150
time [s]
1+2
3
4
5
6
7
8
9

Speed / RCF diagrams

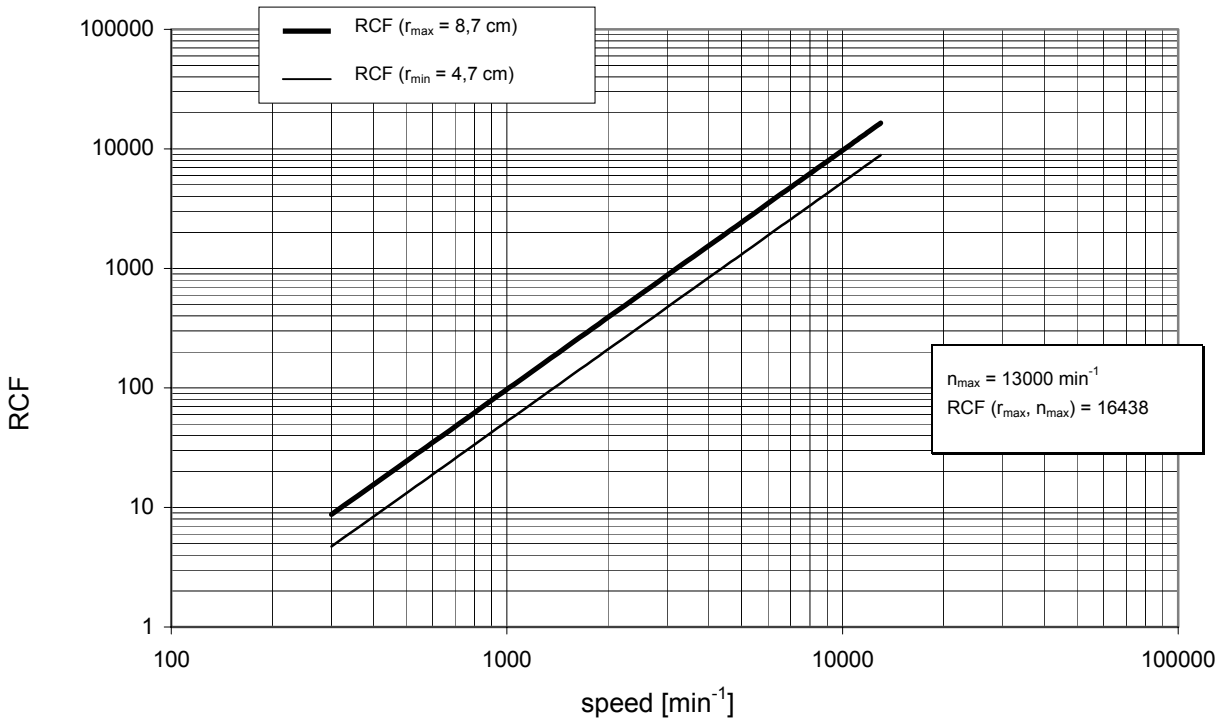
75007590 fixed-angle rotor 6 x 50 ml (Falcon)



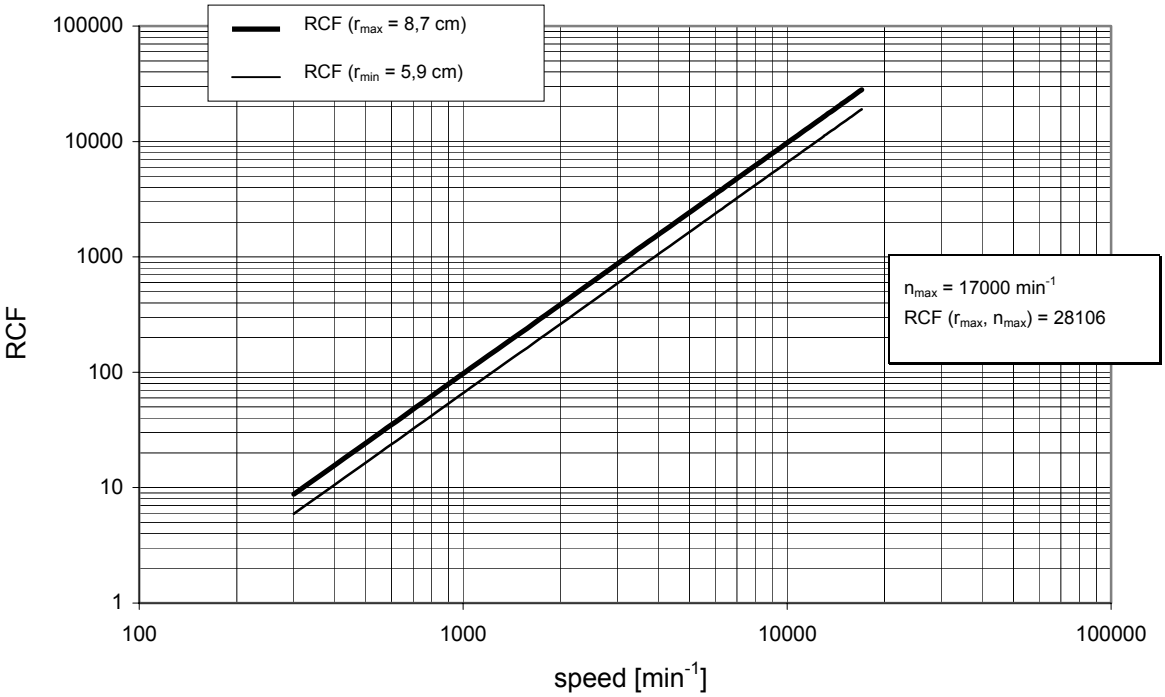
75007591 swinging bucket rotor 4 x 50 ml (Falcon) / 4 x 100 ml

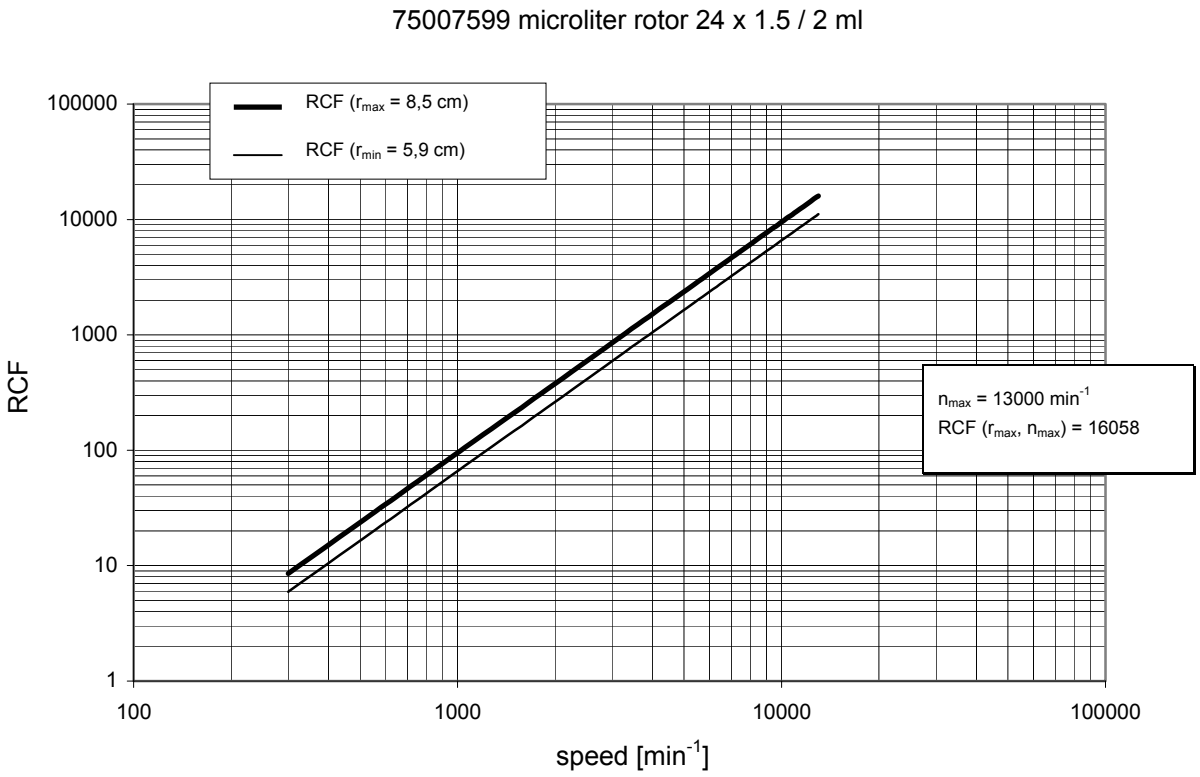


75007592 swinging bucket rotor 12 x 1,5 / 2,0 ml

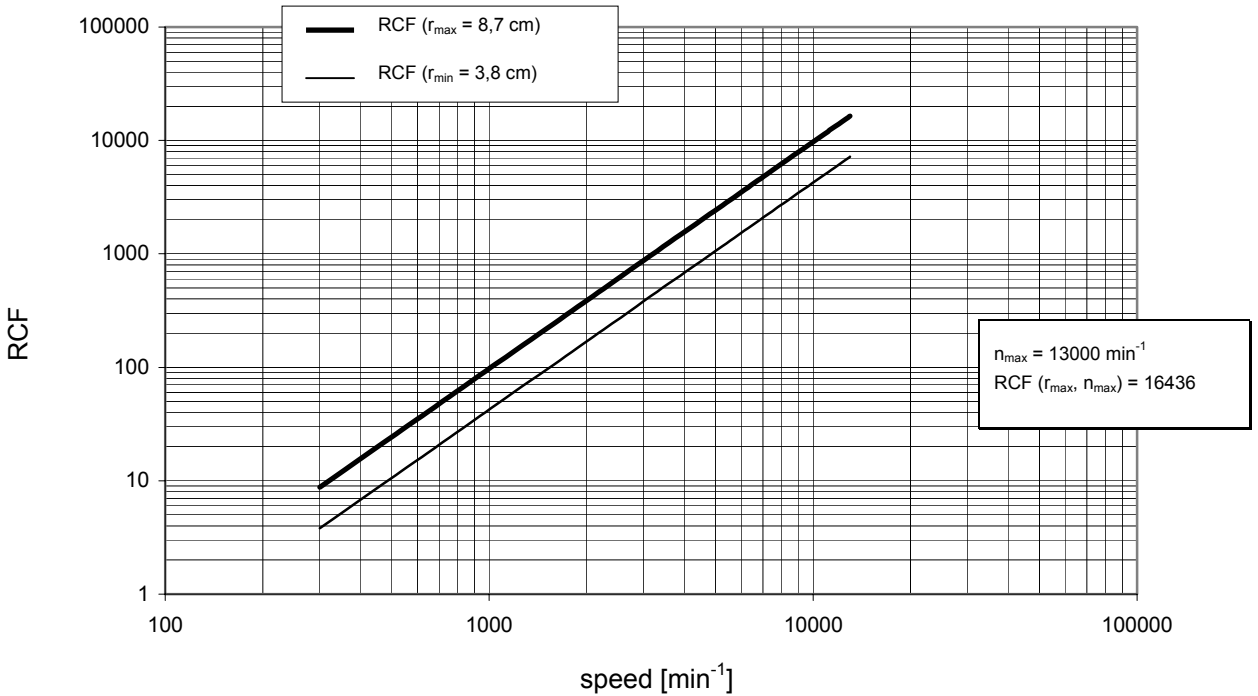


75007593 fixed-angle rotor 24 x 1.5 / 2 ml

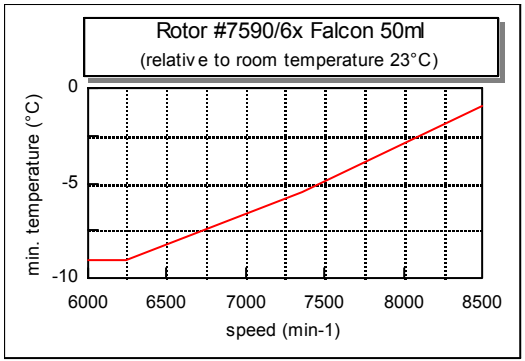


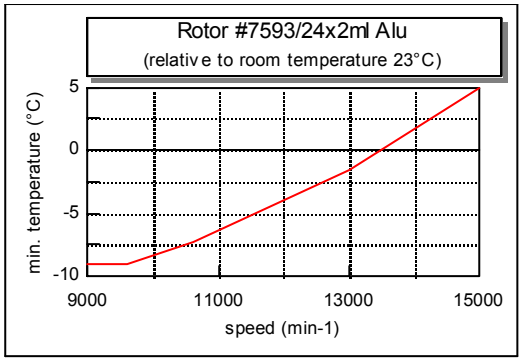

75007599 microliter rotor 24 x 1.5 / 2 ml
RCF (r_{max} = 8,5 cm)
RCF (r_{min} = 5,9 cm)
n_{max} = 13000 min^{-1}
RCF (r_{max}, n_{max}) = 16058
RCF
100000
10000
1000
100
10
1
100
1000
10000
100000
speed [min^{-1}]

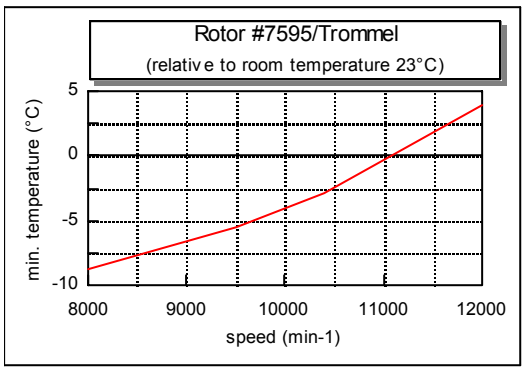
75007595 drum rotor 80 x 2 ml

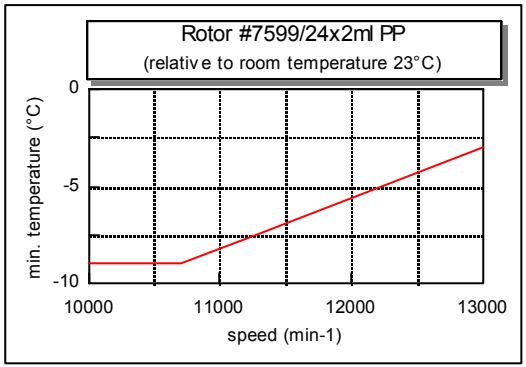


Standard values for minimum sample temperature









Standard values for minimum sample temperature

Autoclaving protocol for rotor 7500 7599				
	Date	Remark	Operator	Signature
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

for your notes

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